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EVALUATION OF HOLOGRAPHIC TECHNOLOGY IN TACTICAL MISSION PLANNING AND EXECUTION

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ABSTRACT

This paper describes holographic technology in the form of digital 3D holographic topographic maps introduced to US Army military personnel users while they served in theater. Assessment data gathered from these personnel is summarized in a table and a chart.

1. INTRODUCTION

This work is preceded by a joint effort between the Air Force Research Lab (AFRL/RHA) in Mesa, AZ, its on-site support contractors (L-3 Communications and The Boeing Company), and Zebra Imaging. This prior effort assessed 3D holographic maps in close air support mission planning and execution and resulted in the publication of a technical report (see Martin. J, 2008).

1.1 Hologram Description

Digital holographic maps, or 3D holographic maps, are three-dimensional images of 3D terrain data that have been permanently recorded on rugged photopolymer film and can be field illuminated by various means, such as green LED lights, and even by flashlight or the sun. Dry-erase markers or grease pencils allow hand annotation. Thousands of 3D holographic maps of urban terrain collected from fused LIDAR and Buckeye Imagery have been deployed to US military personnel in theater since 2007.

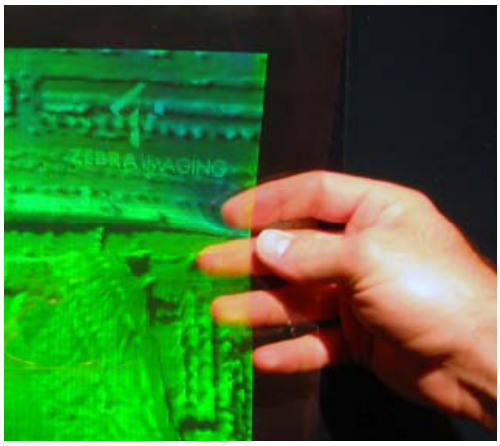


Figure 1: transparent version of a 3D holographic map

1.2 Hologram Uses

The predominant in-theater uses of the 3D holographic maps were in operations planning and in mission briefing and debriefing. More specific cited uses included the following: planning raids, familiarization of unfamiliar terrain, debriefing after incidents, analysis of line-of-sight and sectors of fire, and templating observation posts and sniper positions. At higher map scales mostly used at the brigade, division, and corps levels, e.g. from 1:1,000 up to 1:50,000, a 3D holographic map's urban terrain 3D depth relief is small and offers little or no benefit. User consensus was that the 3D holographic maps were most useful at the lower map scales from 1:100 up to 1:1,000, which are the tactical scales required for team, company, and battalion level use.

2. RATINGS SURVEY METHOD

A dozen field-experienced in-theater users participated in the evaluation. They were surveyed at a variety of CONUS locations where they were posted after their in-theater service. All were shown conventional 2D imagery and 3D holographic maps similar to ones they used in theater, and participated in a written survey and detailed verbal interview. The written survey questionnaire included comparison ratings of various aspects of the 2D and 3D imagery on a scale of 1 to 10. The results of this survey are presented in the next section.

Figure 2: users planning a mission using 3D map

3. RATINGS SURVEY RESULTS

The twelve field-experienced in-theater users compared 2D and 3D maps and subjectively rated them relative to each other on a scale from 1 to 10. They rated 3D holographic maps as more effective than the 2D images for all mission planning and execution tasks. All indicated that the 3D holographic maps are useful for mission planning and/or execution. The most frequently cited benefits of the 3D holographic maps were relative height information, and determining lines of sight and lines of fire. The mean ratings of the twelve users are displayed in the table and chart below (identical data presented in both table and chart).

Planning & Execution Tasks	Mean Rating 2D	Mean Rating 3D
Determine relative heights of non-buildings	3.6	8.0
Determine relative heights of buildings	3.8	8.0
Determine breaks between buildings	4.4	7.9
Determine line of fire	4.7	7.8
Determine line of sight	5.2	8.3
Interrogations	5.0	8.0
Interpret Vegetation	5.3	8.0
Determine relationship to vehicles	4.8	7.4
Position teams, snipers	5.1	7.7
Interpret shadows	5.4	7.6
Determine overwatch positions	5.2	7.3
Determine LZs	6.3	7.4
Define cordons	6.0	6.8
Determine Ingress/Egress Routes	6.9	7.5
All Planning & Execution Tasks (Mean)	**5.1**	**7.7**

The order of the tasks listed in the table and chart is according to the difference between the 2D and 3D ratings. The tasks at the top of the table and chart show a more dramatic benefit of 3D over 2D than the tasks at the bottom of the table and chart.

Users frequently cited that their usage of holograms was limited by the turn-around time of several weeks mostly due to the distant US production location. A few users cited the LIDAR scan and Buckeye imagery data currency was an important issue requiring improvement. The recommended point-source lighting was considered a limitation by some. Standard size A1 (approximately 2' x 3') format 3D holographic maps were useful for planning indoors, and not especially well suited for use in smaller spaces such as inside vehicles or on foot primarily because of the large size. Examples shown of smaller format flip-books incorporating 2D imagery and 3D holographic map pages were unanimously judged by the users as an effective way to address this problem.

These 2D vs. 3D ratings by US Army personnel are very consistent with the 2D vs. 3D ratings by JTACS in the prior AFRL study (see Martin J., 2008).

4. CONCLUSIONS

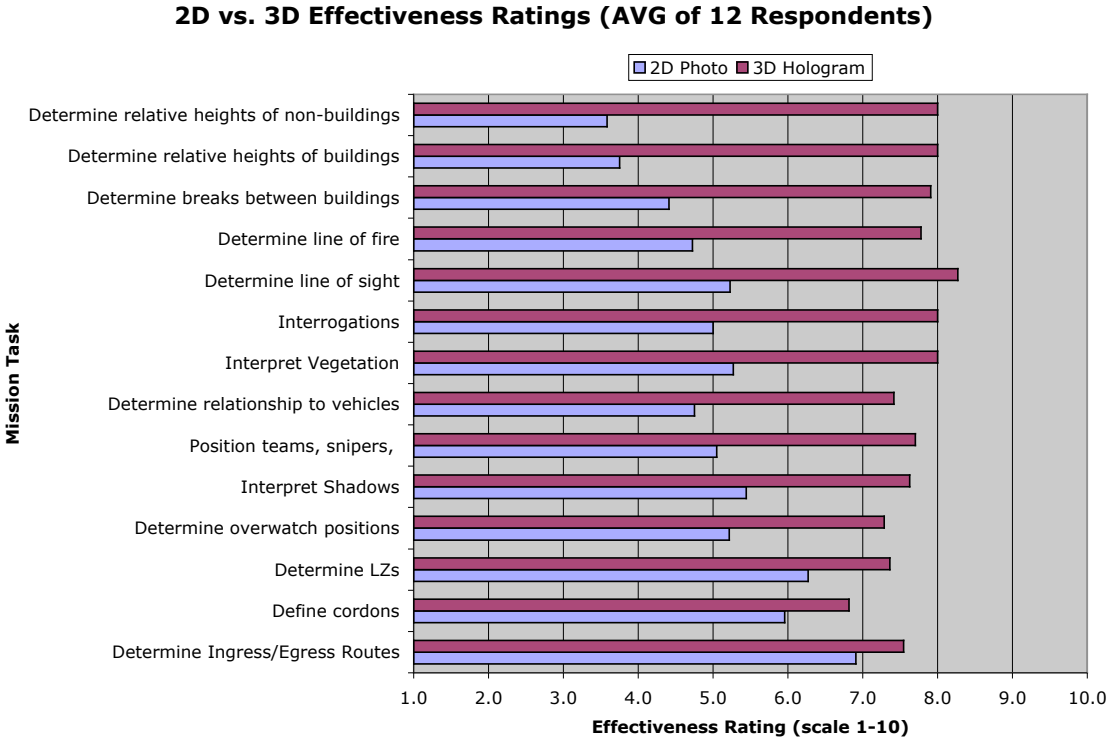
3D holographic maps are effective for both mission planning and execution duties. The 1":15m (about 1:600) scale was considered the most useful for general purposes. Several limitations of the holograms for some uses were noted including slow turn-around time and data currency. All the noted limitations are addressable and the overwhelmingly positive survey ratings suggest it would be worthwhile.

5. RECOMMENDATIONS

The success of this research leads to the primary recommendation that a program of tactical user feedback in a field environment be undertaken. Forward deployed imagers would minimize production turn-around time. Data currency complications are being addressed by LIDAR & Buckeye industry partners. The 2D/3D flip-book concept should be considered further as it promises to enable 3D holographic maps to be used more tactically. Other user recommendations included exploring the integration of 3D holographic maps with current map-related tactical software tools, and exploration of adapting holograms specifically for night missions.

REFERENCES

Martin, J. and Holzbach, M., 2008: Evaluation of Holographic Technology in Close Air Support Mission Planning and Execution, *Air Force Research Laboratory Human Effectiveness Directorate, Warfighter Readiness Research Division, Technical Report approved for public release via www.dtic.mil website, id:* AFRL-RH-AZ-TR-2008-0025, accession number ADA486177


2D vs. 3D Effectiveness Ratings (AVG of 12 Respondents)
2D Photo
3D Hologram
Mission Task
Determine relative heights of non-buildings
Determine relative heights of buildings
Determine breaks between buildings
Determine line of fire
Determine line of sight
Interrogations
Interpret Vegetation
Determine relationship to vehicles
Position teams, snipers,
Interpret Shadows
Determine overwatch positions
Determine LZs
Define cordons
Determine Ingress/Egress Routes
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Effectiveness Rating (scale 1-10)